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1 CONTROL UNIT FOR MULTIPOINT MULTIMEDIA/AUDIO SYSTEM

2

3 BACKGROUND OF THE INVENTION

4 Field of the Invention

5 [0001] The present invention relates generally to conferencing systems, and more
6 particularly to a control unit for a multipoint audio and or multimedia conference.

7

8 Description of Prior Art

9 [0002] In current audio conferences or videoconferences, a participant is an entity that can
10 participate in a single conference (i.e., the participant can speak and/or listen to a single
11 conference). However, often a participant needs to speak to one group and during the same
12 time may need to listen to another group of related or unrelated conferences.

13 [0003] An example for such a need is a conference with two groups of people who do not
14 speak the same language and need translators. For instance, one such scenario includes a group
15 having English speaking individuals, E1 to En, a second group having French speaking
16 individuals, F1 to Fm, a translator from English to French (EF) and a translator from French to
17 English (FE). In such a case, the participants of the conference may desire to have the
18 following related conferences: conference A with participants E1 to En, F1 to Fm, and FE and
19 conference B with participants E1 to En, F1 to Fm, and EF.

20 [0004] The French-speaking individual may want to listen to conference B and the English
21 speaking individuals may want to listen to Conference A. As a result, only the English
22 speaking individuals will hear the FE translator, and the French speaking individuals will hear

1 the EF translator. Another example in which participants of a conference may desire to have
2 more than one conference is if some of the participants want a "Private Room" (a virtual private
3 room) in which a first group of participants can hear a second group of participants, while
4 chatting among themselves without being heard by the second group of participants.

5 [0005] A Multipoint Control Unit (MCU) is a conference controlling entity. The MCU may
6 be a piece of equipment located in a node of the network or in a terminal that receives several
7 channels from access ports and, according to certain criteria, processes audio or audiovisual
8 signals and distributes them to connected channels. The audio signals are processed according
9 to signaling protocol in the circuit switch or packet switched networks such as, but not limited
10 to, Public Switched Telephone Network (PSTN), Integrated Services Digital Network (ISDN),
11 Asynchronous Transfer Mode (ATM), Internet Protocol (IP), Session Initiation Protocol (SIP),
12 H.320, H.323, or a similar protocol. An example of an MCU is MGC-100, which is available
13 from Polycom, Inc. When the MCU is for an audio/multimedia conference, the MCU may
14 process the audio signals and distribute them to connected channels, and may be used for
15 controlling a conference. However, current MCUs cannot fulfill the needs of those individuals
16 desiring to participate in multiple conferences such as the examples given above.

17 [0006] Therefore, it is evident that there is a need for a system and a method, which enables
18 one or more participants to take part in more than one conference.

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1 SUMMARY OF THE INVENTION

2 [0007] The present invention provides a system and a method for controlling an audio or
3 multimedia conference that enables each participant to participate in more than one conference.
4 The present invention may operate in an audio section and in a Management and Control
5 System (MCS) section of an MCU.

6 In the present invention, a bridge may be a logical unit that is identified with a
7 conference. The bridge may include a stream analyze and enhance logical unit, a control unit, a
8 switch, and a mixer. The analyze and enhance logical unit may include a set of algorithms
9 analyzing an audio stream of a participant and enhancing its quality. The analysis and
10 enhancement may include, but is not limited to, ITU G.165 (Echo canceling), DTMF
11 suppression, Voice Activity Detection (VAD), for example. The control unit may be a main
12 control unit for the conference, and may receive all information signals from the stream analyze
13 and enhance logical units. The control unit may select the participants that will be routed for
14 mixing. The switch may be a selector that receives the decoded streams from all the
15 participants in a conference and transfer the selected streams to a mixer. The selection is based
16 on the decisions of the control unit. The mixing unit receives the streams from all of the
17 selected participants and supplies each participant with an uncompressed mixed audio stream
18 from the selected participants. A connection parameter may indicate resources that are
19 allocated to each participant and to each conference. For example, the connection parameter
20 may be a parameter related to a codec that is associated with the participant, and/or a bridge that
21 is associated with the conference. In course of the description, words such as compress and
22 encode may be used interchangeably. Similarly, as the phrases decode, uncompress and open

1 data may be used interchangeably.

2 [0008] Further in the present invention, a Cross-Conference Database (CCDB) may be a
3 management tool that enables participation of at least one participant in two or more
4 conferences simultaneously. The CCDB is a database that holds connection statuses of each
5 participant in all the conferences that are currently managed by the MCU and/or the connection
6 parameters of all the conferences and/or all the participants that are currently connected to the
7 MCU. The connection status may define the status of the participant in a conference. Some
8 examples of connection statuses are Normal, Mute, Force, Speak, Listening, and None. The
9 Mute (M) connection status may mean that the participant cannot be heard in the conference.
10 The Normal (N) connection status may mean that the participant can be heard and can listen to
11 the conference. The Speak (S) connection status may mean that a participant can be heard in
12 the conference but cannot listen to the conference. Optionally, for an N and/or S connection
13 status the participant may be heard only if the signal representing the participant's voice meets
14 certain criteria such as whether the energy level is above a certain value. The Force (F)
15 connection status may mean that the participant must be heard in the conference even if the
16 corresponding participant's voice does not meet the criteria for being heard. The F connection
17 status may also allow the participant to listen to the conference. The Exclusive (E) connection
18 status may mean that the participant is the only one that can be heard in the conference. The
19 Listening (L) or Mute (M) connection status may mean that the participant can listen to the
20 conference without speaking. Finally, the None connection status may mean that the participant
21 has no relations to this conference.

1 [0009] The MCS of the present invention may control the participation of at least one
2 participant in more than one conference by using the Cross Conference Database (CCDB). The
3 MCU may perform connection changes of participants or conferences based on information that
4 is stored in the CCDB. A connection change may be any change in the current situation. A
5 connection change can be, for example, the start of a conference, the termination of a
6 conference, the addition of a participant to the conference, or the muting of a participant. The
7 CCDB can be implemented in a single database or in several databases. For example, there
8 may be a database for each participant that may include the connection status and/or the
9 connection parameters of that participant in every conference that is currently controlled and/or
10 managed by the MCU. As another example, there may be a database for each conference that is
11 currently controlled by the MCU, where the database may include the connection status of all of
12 the participants in the conference and/or the connection parameters of the conference.

13 [0010] In one embodiment, the MCS may have one or more routines that manage the effect
14 of changes in one conference on some of or all of the other conferences, and/or the effect of
15 changes in the connection status of one participant on some of or all of the conferences. In this
16 application, an encoder may be an enhancement and encoding logical unit, compressing the
17 audio signal for participants, based on the communication standard, such as, but not limited to,
18 G.723.1, G.728, G.729, or MPEG. A decoder may be a logical unit for decoding a compressed
19 audio stream, based on the communication standards like but not limited to: G.723.1, G.728,
20 G.729, MPEG. The word "codec" refers to a unit that may be a logical unit and includes a
21 decoder or decoding section and an encoder or encoding section. Also in this application, the
22 word "bridge" refers to a unit, which may be a logical unit, that is associated with the

1 conference. The audio section of an embodiment of the present invention has an architecture
2 that enables multicasting decoded output from each participant's codec to the bridges of all the
3 conferences. Moreover, the audio section may enable routing of the output of any bridge or any
4 of a group of bridges to any participant or any of a group of participants.

5 [0011] Other objects, features, and advantages of the present invention will become
6 apparent upon reading the following detailed description of the embodiments with the
7 accompanying drawings and appended claims.

1 BRIEF DESCRIPTION OF THE DRAWINGS: .

2 [0012] FIG. 1A is a block diagram showing a conference environment;

3 [0013] FIG. 1B is a block diagram of an embodiment of the invention including a
4 general description of an audio unit;

5 [0014] FIG. 1C is a flowchart of a method of operation for the embodiment of FIG. 1B;

6 [0015] FIG. 2 is an example of a Cross-Conferences Database (CCDB);

7 [0016] FIG. 3 is a flow diagram showing the steps of an exemplary method for
8 disconnection of a participant; and

9 [0017] FIG. 4 is a flow diagram showing the steps of an exemplary method for
10 terminating a conference.

1 DESCRIPTION OF EXEMPLARY EMBODIMENTS

2 [0018] Referring now to the drawings, in which like numerals refer to like parts
3 throughout the several views, exemplary embodiments of the present invention are
4 described.

5 [0019] FIG. 1A is an exemplary block diagram illustrating a general description of a
6 conference environment 100 having endpoints 1110aa-nk, operator 1115, multimedia
7 signals 1120aa-nk, multimedia communications 1122a-k, networks 1130a-k, and
8 Multimedia Conference Control Unit (MCCU) 1140. In one exemplary embodiment, the
9 MCCU 1140 may include a Network Interface (NI) 1142, Compressed Audio Common
10 Interface (CACI) 1110, audio unit 1160, Management and Control System (MCS) 1170,
11 control signals 1174, a host 1200, and video unit 1300. Other exemplary embodiments may
12 not have a video section and may be used for audio conferences only.

13 [0020] The pluralities of endpoints 1110aa-nk are connected via the plurality of
14 networks 1130a-k to the MCCU 1140. The MCCU 1140 may be an MCU, or an audio only
15 multipoint control unit (an audio bridge), for example. The MCCU 1140 and/or some or all
16 of its components are logical units that may be implemented by hardware and/or software.
17 The MCS 1170 may be a control module and may be a logical unit that controls the
18 operation of the MCCU 1140.

19 [0021] An endpoint is a terminal on a network, capable of providing one way or two-
20 way audio and/or visual communication with other terminals or with the MCCU 1440. The
21 information communicated between the terminals and/or the MCCU 1440 may include
22 control signals, indicators, audio information, video information, and data. A terminal may
23 provide any combination of several different types of inputs and/or outputs, such as speech

1 only, speech and data, a combination of speech and video, or a combination of speech, data,
2 and video.

3 **[0022]** The NI 1142 receives multimedia communications 1122a-k via a plurality of
4 networks 1130a-k and multimedia signals 1120aa-nk from the plurality of the endpoints
5 1110aa-nk, and processes the multimedia communication according to communication
6 standards that are used by each type of network, such as, but not limited to, H.323, H.321,
7 SIP, and/or H.320. The NI 1142 then delivers compressed audio, compressed video,
8 compressed data, and control streams to appropriate logical modules in the MCU 1140.
9 Some communication standards require that the process of the NI 1142 include
10 demultiplexing the incoming multimedia communication into compressed audio,
11 compressed video, compressed data and control streams. In the opposite direction, the NI
12 1142 receives the separate streams from the various units (e.g., the MCS 1170, audio unit
13 1160, and/or video unit 1300) and processes the streams according to the appropriate
14 communication standard. The NI 1142 then transmits the streams to the appropriate
15 network 1130a-k.

16 **[0023]** The audio unit 1160 receives the compressed audio streams of the plurality of
17 endpoints 1110aa-nk via the NI 1142 and CACI 110, processes the audio streams, mixes the
18 relevant audio streams, and sends the compressed mixed signal via the Compressed Audio
19 Common Interface (CACI) 110 and the NI 1142 to the endpoints 1110aa-nk. Audio unit
20 1160 may be a logical unit and is described below in conjunction to Fig. 1B.

21 **[0024]** The video unit 1300 may be a logical unit that receives and sends compressed
22 video streams. The video unit 1300 includes at least one video input module that handles an
23 input portion of a video stream 1302 from a participating endpoint and at least one video
24 output module that generates a composed compressed video output stream that is sent via

1 Compressed Video Common Interface (CVCI) 1302 to NI 1142 and from there to the
2 designated endpoints 1110aa-nk.

3 [0025] The uncompressed video data is shared by input and output modules on a
4 common interface such as, but not limited to, Time Division Multiplexing (TDM),
5 Asynchronous Transfer Mode (ATM), and/or shared memory. The data on the common
6 interface may be fully uncompressed or even partially compressed. An exemplary operation
7 of such a video unit is described in U.S. Patent Number U.S. 6,300,973, which is
8 incorporated herein by reference.

9 [0026] Preferably, the host 1200 communicates with the operator 1115 of the MCCU
10 1140, where the operator 1115 may have an operator's station for communicating with the
11 host 1200. The host 1200 controls the MCCU 1140 via the MCS 1170 according to
12 instructions from the operator 1115.

13 FIG. 1B is an exemplary block diagram of an embodiment of the invention including a
14 general description of audio unit 1160. The embodiment of FIG. 1B includes a Compressed
15 Audio Common Interface (CACI) 110, a control bus 135, MCS 1170, and audio unit 1160
16 having compressed signals 115 and 117, codec 120, decoded information 126, mixed output
17 128, Decoded Audio Common Interface (DACI) 140, and bridge 150. The codec 120
18 includes a decoder 122 and an encoder 124, while the bridge 150 includes analyze and
19 enhance unit 152, information signal 153, control unit 154, switch 156, control signals 157,
20 selected signals 159, mixer 160, and mixed signal 161. FIG. 1B describes the flow of audio
21 streams in one example of the present invention. Compressed audio streams, from all
22 endpoints that are connected to an MCU are transferred over the Compressed Audio
23 Common Interface (CACI) 110. The MCS 1170 allocates a codec 120 to each one of the
24 endpoint 1110aa-nk (FIG. 1A).

1 [0027] Further, the CACI 110 carries signals to and from endpoints 1110aa-nk. For
2 example, the compressed signal 115 from one of the endpoint 1110aa-nk is routed through
3 the CACI 110 to the decoder 122 in the codec 120, which was previously allocated to that
4 endpoint by the MCS 1170 via control bus 135. The decoder 122 may be a logical unit and
5 may decode a compressed audio stream, based on the communication standards such as, but
6 not limited to, G.723.1, G.728, G.729, MPEG. The decoder 122 then decodes the
7 compressed audio stream, such as compressed signal 115, and broadcasts the decoded signal
8 126 over the Decoded Audio Common Interface (DACI) 140. The DACI 140 is a bus that
9 may have broadcasting capabilities. The DACI 140 may be implemented for example by
10 any one of or any combination of Time Division Multiplexing (TDM), Asynchronous
11 Transmission Mode (ATM), Local Area Network (LAN), wireless technology, or shared
12 memory. The bridge 150 may then grab the decoded signal from the DACI 140 and may
13 analyze, enhance, and/or mix the decoded signal and return the output 161 to the DACI 140.

14 [0028] The encoder 124 may be a logical unit and may be an enhancement and/or
15 encoding unit. The encoder 124 may compress the output 128 of the appropriate bridge 150
16 forming a compressed audio stream, such as the compressed signal 117, based on the
17 communication standard such as, but not limited to, G.723.1, G.728, G.729, and/or Motion
18 Picture Expert Group (MPEG).

19 [0029] The MCS 1170 generates a Cross-Conferences Database (CCDB) based on the
20 required setup of all the participants and all the conferences that currently exist in the MCU.
21 The CCDB is a Cross-Conference Database that holds the connection parameters (e.g.,
22 codecs and bridges, etc.) and the connection status (e.g., Normal, Mute etc.) of each
23 endpoint (participant) that is currently connected to the MCU, in every conference that is
24 currently managed by the MCU. The CCDB enables the participation of at least one

1 participant in more than one conference. The CCDB is described below in conjunction with
2 Fig 2. According to the CCDB, the MCS 1170 programs one or more bridges 150 to grab
3 from the DACI 140 the decoded signals of all the participants associated with a conference
4 that is assigned to those bridges 150.

5 [0030] The decoded output of any codec 120 can be grabbed by more than one bridge
6 150 allowing the participants to be associated with more than one conference. The decoded
7 streams from the decoders 122 on the DACI 140 may be grabbed by the bridge 150 and then
8 analyzed and enhanced by the analyze and enhance unit 152. The analyze and enhance unit
9 152 may be a logical unit, and may include a set of algorithms for analyzing an audio stream
10 of a participant and/or enhancing its quality, such as, but not limited to, International
11 Telecommunications Union (ITU) G.165 (echo canceling), Dual Tone Multi-Frequency
12 (DTMF) suppression, and/or Voice Activity Detector (VAD).

13 [0031] The bridge 150 may have one or more analyze and enhance units 152. Each
14 analyze and enhance unit 152 is assigned to a single participant and is programmed
15 according to the connection status of that participant in the conference. The control unit 154
16 controls a conference that receives all signals from the analyze and enhance unit 152 and
17 selects the participants that will be routed via switch 156 to the mixer 160. The mixer 160
18 receives the enhanced streams from all of the selected participants and supplies each
19 participant with an uncompressed mixed audio stream of the selected participants.

20 Signals from the analyze and enhance unit 152 are sent to the control unit 154 and the
21 enhanced decoded audio signals are sent from the analyze and enhance units 152 to the
22 switch unit 156. The switch unit 156 is a selector that receives the decoded streams from all
23 the participants in a conference and transfers the selected streams to the mixer 160. The
24 selection is based on the decisions of the control unit 154. Based on received commands

1 from the MCS 1170, which define the connection status of the participants in the conference
2 that is assigned to the bridge 150, and the information signal 153 from the analyze and
3 enhance unit 152 the control unit 154 controls, via control signals 157, the switch 156, and
4 the mixer 160. For example, in a case where a participant's connection status is Normal (N),
5 the analyze and enhance unit 152 that is associated with that participant may indicate that
6 the voice signal meets a certain criteria such as set forth by VAD, (e.g., such as the energy
7 level being above a certain value.). Then, the control unit 154 via switch 156 selects the
8 output of the analyze and enhance unit 152, which is assigned to the participant, as one of
9 the inputs to the mixer 160. The mixer 160 mixes the selected audio signals to form the
10 mixed signal 161, and broadcasts the mixed signal 161 over the DACI 140. Some
11 embodiments of the bridge 150 have the capability of eliminating the voice of a speaker
12 from the mixed signal that is aimed to the endpoint of that speaker.

13 [0032] The MCS 1170, based on the connection status stored in the CCDB, commands
14 one or more codecs 120 to grab the mixed output 128 from the DACI 140 for listening to the
15 conference. After grabbing the mixed output 128 from the DACI 140, the encoder 124
16 encodes the decoded signal from the appropriate bridge 150, and sends the compressed
17 signal 117 via the CACI 110 to the appropriate participant.

18 [0033] The codecs 120 and the bridges 150 may be implemented by Digital Signal
19 Processors (DSPs) such as, but not limited to, Texas Instruments DSP, TMS320C31. One
20 DSP can include more than one unit (e.g., more than one codec and/or bridge). In the above
21 example, the codec 120 handles a single participant's audio signal, and the bridge 150
22 handles one conference.

23 [0034] Referring now to FIG. 1C, a flowchart depicting a method 170 for the operation
24 of the system of FIG. 1B is shown. In the method 170, the mixed signal is broadcasted back

1 to the endpoints 1110aa-nk (FIG. 1A). Specifically, the method 170 starts with step 172 in
2 which the MCS 1170 (FIG. 1A) receives signals from the host 1200 (FIG. 1A) or from one
3 or more endpoints 1110aa-nk (FIG. 1A) related to the configuration of the conference or
4 conferences in progress or that needs to be initiated. The endpoints 1110aa-nk communicate
5 with the MCS 1170 indirectly by sending multimedia signals 1120aa-nk (FIG. 1A) to
6 networks a-k which in turn send multimedia communications 1122a-k (FIG. 1A) to the NI
7 1142 (FIG. 1A). Then, the NI 1142 responds to the multimedia communication 1122a-k by
8 sending control signal 1174 to the MCS 1170 to set up the conference. In one embodiment,
9 the audio unit 1160 (FIG. 1A) and/or the video unit 1300 (FIG. 1A) may send control
10 signals to the MCS 1170 for setting up the conference in addition to or instead of the control
11 signals 1174 (FIG. 1A).

12 **[0035]** Next, in step 174, the MCS 1170 creates and/or updates one or more CCDBs in
13 which the information about how the conferences are to be setup is stored, and broadcasts
14 control signals on the control bus 135 (FIG. 1B). Subsequently, the codecs 120 (FIG. 1B)
15 receive and/or grab control signals from control bus 135 associating individual codecs 120
16 with endpoints and/or participants according to the configuration of the conferences in the
17 CCDB in step 176. Then, in step 178, the bridges 150 (FIG. 1B) grab and/or receive control
18 signals from the control bus 135 associating each analyze and enhance unit 152 with an
19 endpoint and/or participant. Next, compressed audio signals from one or more endpoints are
20 placed or broadcasted on the CACI 110 (FIG. 1B) in step 180. Subsequently in step 182,
21 the corresponding decoder 122 (FIG. 1B) of the codec 120 may grab and/or receive the
22 compressed signal 115 (FIG. 1B) from the CACI 110 and decodes the compressed signal
23 115 to produce the decoded signal 126 (FIG. 1B) and broadcasts the decoded signal 126 on
24 the DACI 140 (FIG. 1B).

1 [0036] Subsequently, in step 184, the analyze and enhance unit 152 (FIG. 1B) grabs
2 and/or receives the decoded signal 141 (FIG. 1B) (which may be derived from the decoded
3 signal 126) from the DACI 140 according to control signals from the MCS 1170, which is
4 driven from CCDB (step 174). Also, in step 184, the analyze and enhance unit 152
5 enhances the decoded signal 141 to form the enhanced signal 155 (FIG. 1B), and extracts
6 the control information 153 (FIG. 1B). The enhanced signal 155 is then sent to the switch
7 156 (FIG. 1B), and the control information 153 is sent to the control unit 154 (FIG. 1B).

8 [0037] The control unit 154 produces control signals 157 (FIG. 1B) based upon control
9 signals from the MCS 1170 (which are driven from CCDB in step 174) and/or control
10 information 153 in step 190. Based on the control signal 157 and/or control signals from the
11 MCS 1170, the switch 156 selects which enhanced signals 155 are sent as selected signals
12 159 (FIG. 1B) to the mixer 160 (FIG. 1B) in step 191. In response, in step 192, the mixer
13 160 mixes the selected signals 159 to form the mixed signal 161 (FIG. 1B) according to
14 control signals from the MCS 1170 and broadcasts the mixed signal 161 onto the DACI 140.
15 One or more encoders 124 (FIG. 1B), based on CCDB (step 174), may grab and/or receive
16 the mixed output 128 (which may be derived from mixed signal 161), and encode the mixed
17 output 128 to form the compressed audio signal 117 (FIG. 1B) in step 194. The compressed
18 audio signal 117 is then broadcasted onto the CACI 110. Finally, in step 196, the endpoints
19 1110aa-nk grab and/or receive the mixed compressed audio signal via the NI 1142 and
20 networks 1130a-k.

21 [0038] The steps of the method 170 have been presented in an order that facilitates
22 understanding the method. However, the steps of the method 170 can be performed in any
23 order. Since some endpoints, according to the information stored in CCDB (step 174), may
24 only be able to talk and some may only be able to listen, some codecs 120 (associated with a

1 talk only endpoint) may grab and/or receive the compressed signals 115 from a particular
2 endpoint, and broadcast the compressed signals 117 (for other endpoints to listen to), while
3 other codecs 120 may not grab or receive the compressed signals 115 (from their associated
4 endpoint), but may nonetheless send the mixed compressed signals 117 to their associated
5 endpoint.

6 [0039] FIG. 2 is an example of a CCDB. Each column represents a conference and the
7 bridge 150 (FIG. 1A) that is associated with that conference. In FIG. 2, the participants are
8 labeled 1 to N+2, and the conferences are labeled A-X. The bridges used for the conference
9 are labeled B1-Bz. French speaking participants are marked with an "F," and English
10 speaking participants are marked with an "E." The English to French translator is marked
11 with an "EF," and the French to English translator is marked with an "FE." The codecs in
12 use are labeled C01-Ck. Cells marked "N" have a status of Normal, cells marked "S" have a
13 status of Speak, and empty cells have a status of "None."

14 [0040] For example, column A 202 (i.e., conference A) uses bridge # 3 (i.e., B3), and
15 the first row 204 is participant #1 who is using codec # 11 (C11) 206. The current example
16 presents a case with five conferences. The first conference is conference A, which uses B3
17 as the bridge. Conference A has six participants, labeled 1, 2, 3, 4, 5, and 6, which use the
18 codecs 120 (FIG. 1B) having numbers C11, C21, C13, C05, C07, and C06, respectively. In
19 this conference, the connection status of the participants 1, 3, 5 (the English speaking
20 individuals) and 6 (French to English translator) is "Normal" (N). The N connection status
21 may mean that a participant can speak and listen to the conference. The bridge 150
22 associated with the conference, in this case bridge B3, grabs the decoded information 126
23 (FIG. 1B) from each decoder 122 (FIG. 1B) associated with one of the participants 1, 2, 3, 4,
24 5, and 6 so that the decoded information of these participants can be mixed with the other

1 audio signals of the conference, and participants 1, 2, 3, 4, 5, and 6 can be heard. For each
2 participant 1, 3, 5, and 6, the encoder 124 (FIG. 1B) associated with that participant grabs
3 the mixed output 128 (FIG. 1B) of the bridge (B3) so that participants 1, 3, 5, and 6 can
4 listen to the conference.

5 [0041] In conference A, the connection status of participants 2 and 4 (the French
6 speaking persons) is "Speak" (S). The S connection status means that participants 2 and 4
7 can be heard in the conference but cannot listen to the conference. For each participant 2
8 and 4, the bridge 150 associated with the conference, in this case bridge B3, grabs the
9 decoded information 126 from the decoder 122 associated with that participant so that the
10 decoded information can be mixed with the other audio signals of the conference, and
11 participants 2 and 4 can be heard.

12 [0042] A second exemplary conference, conference B, uses bridge B1. Conference B
13 has six participants 1, 2, 3, 4, 5, and 7 that use codec numbers C11, C21, C13, C05, C07,
14 and C17, respectively, and are connected to the conference. In this conference, the
15 connection status of participants 1, 3, and 5 (the English speaking individuals) is S.
16 Consequently, participants 1, 3, and 5 can be heard in the conference but cannot listen to the
17 conference. The bridge 150 associated with the conference, bridge B1, grabs the decoded
18 information 126 from the decoder 122 of participants 1, 3, and 5 so that their audio signals
19 can be mixed with the rest of the audio signals of the conference allowing participants 1, 3,
20 and 5 to be heard.

21 [0043] Continuing with conference B, the connection status of participants 2, 4 (the
22 French speaking individuals) and 7 (English to French translator) is "Normal" (N). Thus,
23 participants 2, 4, and 7 can both speak and listen to the conference. The speech of each one
24 of the participants 2, 4, and 7 is enabled by the bridge B1 grabbing the decoded information

1 126 from the decoder 122 associated with those participants, so that the decoded
2 information of these participants can be mixed with the other audio signals of the
3 conference, and participants 2, 4, and 7 can be heard. The listening process of one of the
4 participants is enabled by the encoder 124 associated with that participant grabbing the
5 mixed output 128 of the bridge (B1).

6 [0044] The third exemplary conference, conference C, uses bridge B5, and has two
7 participants 8 and 9, whom are using codecs having numbers C08 and C01, respectively. In
8 this conference the connection status of both participants is "Normal" (N).

9 [0045] In the fourth exemplary conference, conference D, bridge B4 is used.
10 Conference D has four participants 8, 9, 10, and 11, who are using codecs numbered C08,
11 C01, C10, and C04, respectively. In conference D, the connection status of participants 8
12 and 9 is Speak (S). The S connection status means that participants 8 and 9 can be heard in
13 the conference but cannot listen to the conference. For each participant 8 and 9, the bridge
14 150 associated with the conference, in this case bridge B4, grabs the decoded information
15 126 from the decoder 122 associated with that participant so that the decoded information
16 can be mixed with the other audio signals of the conference, and participants 8 and 9 can be
17 heard. The connection status of participants 10 and 11 is "Normal" (N). Consequently, for
18 each of participants 10 and 11, bridge B4, grabs the decoded information 126 from the
19 decoder 122 associated with that participant, and the encoder 124 of that participant grabs
20 the mixed output 128 of the bridge B4.

21 [0046] The final exemplary embodiment, conference X, uses bridge Bz, and has 3
22 participants N, N+1 and N+2 who are using codecs numbered Cm, Cl, and Ck, respectively.
23 Conference X is a common conference where the connection status of all the participants is
24 "Normal" (N).

1 [0047] The above example illustrates at least two special cases. The first case is a
2 combination of two related conferences A and B, which is a conference of three English
3 speaking individuals with a translator from French to English (FE) and French speaking
4 individual with a translator from English to French (EF).

5 [0048] The second case is the combination of two related conferences C and D, which
6 can be a case in which two individuals 8 and 9 are discussing an issue among themselves
7 while their peers 10 and 11 can listen to them. The peers 10 and 11 can thus have an
8 internal discussion between themselves without being heard by the individuals 8 and 9.

9 [0049] An instance of a participant in a conference may be a call to (or rather an
10 instantiation of) an object representing a particular participant. The existence of an instance
11 of a participant implies that the participant's connection status in the conference is not
12 "None." In other embodiments, conferences may use connection statuses such as, but not
13 limited to, "Exclusive" (E) and "Listening" (L). In E status, the participant is the only one
14 that can be heard in the conference. Alternatively, L status allows the participant to listen to
15 the conference without speaking.

16 [0050] One or both connection statuses, E and L, may be used in an embodiment with
17 any one of, any combination of, or all of connection statuses M, N, and None. For example,
18 one embodiment may include connection statuses N, E, L, and None while another
19 embodiment may include M, N, E, S, and None.

20 [0051] In the present specification a connection change is any change in a current
21 situation or configuration of the conference. The connection change can be, for example, to
22 start a conference, terminate a conference, add a participant, or mute a participant. Based on
23 the information embedded in the CCDB, the MCS 1170 (FIG. 1A) may perform connection
24 changes by sending commands to the decoder 122 and the encoder 124 of the codec 120 that

1 determine which information to grab from the CACI 110 (FIG. 1A) and/or the DACI 140
2 (FIG. 1B), respectively, and/or by sending commands to the bridge 150 determining which
3 information to grab from the DACI 140.

4 **[0052]** The present invention is not limited to any specific type of database, and may use
5 types of databases other than the ones explicitly disclosed above. For example, the database
6 CCDB may include a bank of databases, having one database for each participant. The
7 database of a participant may have the participant's connection status in each conference.
8 Alternatively, or in addition to this bank of databases, CCDB may have a bank of databases
9 having one database for each conference. Each database may include the participants that
10 are involved with that conference. The various databases may be related to each other
11 enabling the controller to move from one database to the other.

12 **[0053]** FIG. 3 is a flowchart showing the steps of an exemplary method 300 for
13 disconnecting a participant. The method 300 updates the conference connections that are
14 affected by the participant disconnecting. Further, the method 300 ensures that the
15 participant is no longer connected to any conference. Also, a participant being disconnected
16 can place a conference in a state where the conference should be terminated (because, for
17 example, there is only one participant left in that conference). Consequently, the method
18 300 also ensures that any conference that should be terminated as a result of the
19 disconnection is actually terminated.

20 **[0054]** When the MCS 1170 (FIG. 1A) receives a control signal 1174 (FIG. 1a), either
21 from the host 1200 (FIG. 1A) or from NI 1142 (FIG. 1A), that a participant has been
22 disconnected, in step 310, the MCS 1170 starts a disconnection routine associated with the
23 method 300. In step 320, the MCS 1170 searches for the CCDB entry related to the

1 participant that has been disconnected. In this step the appropriate row in the CCDB of FIG.
2 2, for example, is found.

3 [0055] Then in step 330, the MCS 1170 starts the conference loop, which is a loop
4 including all conferences that are currently managed by the MCU. The loop may be
5 searched conference by conference. For example, MCS 1170 may check how many
6 conferences are currently managed by the MCU and may store this parameter, K. Then the
7 MCS 1170 may give the value 1 to a variable j and move along the appropriate row, in the
8 CCDB of FIG. 2, for example, to the first conference found.

9 [0056] In step 340, the MCS 1170 may check if the connection status of the
10 disconnected participant in the current conference is "None." If it is different than "None,"
11 then the MCS 1170 moves to step 350. Otherwise, MCS 1170 moves to step 385. In step
12 350, the MCS 1170 may update the CCDB of FIG. 2, for example, with the new situation,
13 (e.g., changes the connection status of the participant to "None"). Subsequently, in step 360
14 MCS 1170 may send signals to the rest of the participants in the conference indicating that
15 one of the participants has been disconnected.

16 [0057] Then, the MCS 1170 may perform a check, step 370, for whether a termination
17 condition is met. The termination condition may occur when there are less than two
18 participants. Alternatively, the termination condition may occur when the number of
19 participants falls below a predetermined threshold. The predetermined threshold may be
20 determined by financial or other considerations, for example. The termination condition
21 may include a request to terminate the conference, which may be required in addition to or
22 instead of the number of participants falling below a predetermined number. Termination of
23 a conference can be done by the method described in conjunction with FIG. 4. The
24 termination condition may be a logical function of several termination conditions, and may

1 change dynamically according to a termination policy. If the termination condition is met,
2 the MCS 1170 may move to step 365 and terminate the conference. However, if the
3 termination condition is not met (for example, if there are more than two participants), the
4 MCS 1170 enables the continuation of the conference and moves to step 385.

5 [0058] In step 385, the MCS 1170 may increase the variable j by 1, and check, in step
6 390, if an exit condition for exiting the loop is met. For example, an exit condition may be a
7 condition indicative of all conferences being checked (e.g., $j=K$). The MCS 1170 then
8 moves to step 395 and exits the loop, thereby, terminating the disconnection method.
9 Otherwise, in step 397 MCS 1170 moves to the next conference in the row and returns to
10 step 340. Although in the example of the method 300 the participant is disconnected from
11 all the conferences, a similar method could be used for disconnecting the participant from all
12 but one or more specified conferences.

13 [0059] FIG. 4 is a flow diagram illustrating the steps of an exemplary method 400 for
14 terminating a conference (i.e., step 365 of FIG. 3). The method 400 notifies all participants
15 of a conference that the conference is being terminated. If a participant is connected to the
16 conference, and if the situation of the participant meets the disconnection criteria, the
17 method 400 also disconnects the participant. After terminating the conference, the CCDB
18 needs to be updated so that MCS 1170 (FIG. 1A) no longer sends control signals related to
19 the terminated conference. Consequently, after notifying and disconnecting the participants,
20 as appropriate, the method 400 updates the CCDB to reflect the conference being
21 disconnected.

22 [0060] When the MCS 1170 receives a command to terminate a conference in step 410,
23 the MCS 1170 may start the termination routine of method 400. In step 420, the MCS 1170

1 searches for the CCDB entry related to the conference to be terminated. For example, this
2 step finds the appropriate column in the CCDB of FIG. 2.

3 [0061] Then in step 430, the MCS 1170 starts the participant loop, which may be a loop
4 that includes all participants that are currently connected to the conference. The MCS 1170
5 may check how many participants are currently connected to the conference and store the
6 number of participants (parameter P). Then MCS 1170 (FIG. 1) may give a value 1 to a
7 variable j, and move along the appropriate column (or conference) to the first participant.
8 Then in step 435, the MCS 1170 updates the CCDB, with the new conference state (e.g., the
9 connection status of the participant, which is associated with the variable j, is changed to
10 "None").

11 [0062] In step 440, the MCS 1170 checks for a termination condition for the participant
12 j. For example, a termination condition may be when the participant is not connected to any
13 other conference. The check may be performed by observing the corresponding row of the
14 participant in the CCDB. Unless the participant has any relation to or any instance in any
15 other conference, then the termination condition of participant j is met. In this example, if
16 the participant has any instance in any other conference, then the MCS 1170 moves to step
17 445, else the MCS 1170 moves to step 450. In step 450, the MCS 1170 sends an indication
18 to participant j that the conference is terminated and in step 455 disconnects participant j. In
19 another exemplary method, the MCS 1170 may have another termination condition or policy
20 to disconnect a participant. The termination condition may be dynamic and may require a
21 request for termination for the participant and/or other entity in addition to or as an
22 alternative to the participant having a status of "None" in all conferences. If the termination
23 condition is not met, for example, if the participant is connected to any other conference

1 440, then the MCS 1170 sends the operator and/or the participant an indication, in step 445,
2 that the current conference is terminated and the method 400 moves to step 465.

3 [0063] In step 465, the MCS 1170 may increase variable j by 1 and check, in step 470,
4 whether $j=P$. If $j=P$, the MCS 1170 may move to step 477 and remove the appropriate
5 column from the CCDB. Next, the method 400 moves to step 480, and finishes the
6 conference termination. Otherwise (if $j \neq P$), the MCS 1170 will return to step 435 where the
7 next participant in the column is processed.

8 [0064] Those skilled in the art will appreciate that the MCS 1170 can be any one of or
9 any combination of software, hardware, and/or firmware. If the MCS 1170 is software, the
10 MCS 1170 may reside in the host computer of the associated MCU. Alternatively, if the
11 MCS 1170 is hardware, the MCS 1170 may be an additional unit located in the MCU.

12 [0065] Furthermore, those skilled in the art will appreciate that the CCDB can be
13 implemented in a single database or in several related databases. For example, the CCDB
14 may be located in a bank of databases having one database per each participant, which may
15 include the connection status of said participant in every conference that is currently
16 controlled by the MCU and/or the connection parameters of the participant.

17 [0066] In the description and claims of the present application, each of the verbs,
18 "comprise," "include," "have," and conjugations thereof, are used to indicate that the object
19 or objects of the verb are not necessarily a complete listing of members, components,
20 elements or parts of the subject or subjects of the verb. The present invention has been
21 described using detailed descriptions of methods thereof that are provided by way of
22 example and are not intended to limit the scope of the invention. The described methods
23 comprise different features, not all of which are required in all embodiments of the
24 invention. Some embodiments of the present invention utilize only some of the features or

- 1 possible combinations of the features. Variations of embodiments of the present invention
- 2 that are described and embodiments of the present invention having different combinations
- 3 of features noted in the described embodiments will occur to persons of the art. The scope of
- 4 the invention is limited only by the following claims.

WHAT IS CLAIMED

- 1 1. A method for controlling conferences of a plurality of participants having at least one
2 participant that can participate in two or more conferences simultaneously, the method
3 comprising:
4 creating a cross conference database, the cross conference database including selected
5 connection parameters and selected connection statuses; and
6 performing a connection change based on the cross conference database.
- 1 2. The method of claim 1, wherein performing a connection change comprises:
2 determining how the connection change affects each of the conferences and the
3 participants.
- 1 3. The method of claim 2, wherein performing a connection change comprises:
2 updating the cross conference database according to a result of the determining.
- 1 4. The method of claim 2, wherein performing a connection change comprises:
2 implementing a result of the updating.
- 1 5. The method of claim 1, wherein performing connection change comprises:
2 detecting all participants and all conferences involved in the connection change;

3 determining how the connection change affects each of the conferences and the
4 participants;
5 updating the cross conference database according to a result of the determining; and
6 implementing a result of the updating.

1 6. The method of claim 1 further comprising notifying each of the participants affected by the
2 connection change about the connection change before performing the connection change.

1 7. The method of claim 1 wherein the connection parameters include a parameter associated
2 with a codec that is associated with each participant.

1 8. The method of claim 1 wherein the connection parameters include a parameter associated
2 with a bridge that is associated with each conference.

1 9. The method of claim 1 wherein at least one of the connection statuses is associated with a
2 participant in the conferences.

1 10. The method of claim 1 wherein the connection status is capable of having statuses of listen.

1 11. The method of claim 1 wherein the connection status is capable of having statuses of
2 exclusive.

- 1 12. The method of claim 1 wherein the connection status is capable of having statuses of mute.
- 1 13. The method of claim 1 wherein the connection status is capable of having statuses of force.
- 1 14. The method of claim 1 wherein the connection status is capable of having statuses of
2 normal.
- 1 15. The method of claim 1 wherein the connection status is capable of having statuses of none.
- 1 16. The method of claim 1 wherein the connection status is capable of having statuses of
2 normal, none, exclusive, mute, force, speak, and listen.
- 1 17. The method of claim 1 wherein the conference is an audio conference.
- 1 18. The method of claim 1 wherein the conference is a multimedia conference.
- 1

1 19. A method comprising conducting a conference by:
2 receiving audio signals from a plurality of endpoints;
3 broadcasting the audio signal onto an audio common interface;
4 selecting at least one audio signal to be mixed, the selecting is performed
5 using a cross conference reference table to determine a selection;
6 mixing the selected audio signal; and
7 transmitting the mixed signal to at least one end point;
wherein at least one participant can participant in two or more conferences.

1 20. A method comprising:
2 creating a cross conference database;
3 establishing at least one conference having at least one participant that
4 participates in at least one other conference by
5 updating a cross connection database; and
6 conducting the conference by
7 receiving audio signals from a plurality of endpoints,
8 broadcasting the audio signal onto an audio common interface,
9 selecting at least one audio signal to be mixed, the selecting is performed
10 using a cross conference reference table to determine a selection,
11 mixing the selected audio signal, and
12 transmitting the mixed signal to at least one end point.

1 21. The method of claim 20 wherein the receiving further comprises processing the received
2 audio signals, the processing is performed using the cross conference database to determine
3 which module performs a process.

1 22. The method of claim 21 wherein the audio signals that were received are encoded.

1 23. The method of claim 22 wherein the processing the received audio signals includes
2 decoding of the received audio signals.

1 24. The method of claim 23 wherein processing the received audio signals includes analyzing
2 the decoded audio signals.

1 25. The method of claim 21 wherein transmitting the mixed signal is performed based on the
2 cross conference database.

1 26. The method of claim 21 wherein the module is a codec.

1 27. The method of claim 20 wherein performing a connection change based on the cross
2 conference database, including:

3 detecting all participants and all conferences involved in the connection change,

4 determining how the connection change affects each of the conferences and the

5 participants,

- 6 updating the cross conference database according to a result of the determining,
- 7 implementing a result of the updating.

- 1 28. A multipoint control unit comprising:
 - 2 a management and control system that manages the participation of at least one
 - 3 participant in two or more conferences.
- 1 29. The multipoint control unit of claim 28 wherein the management and control system
 - 2 includes a cross conference database.
- 1 30. The multipoint control unit of claim 28 wherein two or more of the conferences are related
 - 2 to one another.

1 31. A system comprising:
2 a multipoint control unit having a management and control system for managing and
3 controlling two or more related conferences.

1 32. The system of claim 31 wherein two of the conferences are related by having at least one
2 participant participating in both conferences.

1 33. The system of claim 31 wherein the system
2 creates a cross conference database, the cross conference database including selected
3 connection parameters and selected connection statuses.

1 34. The system of claim 33 wherein the system
2 performs a connection change based on the cross conference database by
3 detecting all participants and all conferences involved in the connection change,
4 determining how the connection change affects each of the conferences and the
5 participants,
6 updating the cross conference database according to a result the determining, and
7 implementing a result of the updating.

1 35. The system of claim 32 wherein the management control system

2 notifies each of the participants affected by the connection change about the connection
3 change before performing the connection change.

1 36. The system of claim 31 further comprising a codec.

1

2 37. The system of claim 36 wherein the codec

3 receives signals from the compressed audio common interface,

4 decodes the signals, wherein the receiving is done using the cross conference

5 database, and

6 broad casts the signals that have been decoded onto the decoded audio common

7 interface.

1 38. The system of claim 36 wherein the codec

2 receives a mixed output from the decoded audio common interface,

3 encodes the mixed output, and

4 broadcasts the mixed output that was encoded onto a compressed audio common

5 interface.

1 39. The system of claim 31 further comprising a bridge.

1

2 40. The system of claim 39 wherein the bridge mixes a selected group of decoded audio signals
3 associated with the conference to produce a mixed output, wherein the selection is done
4 using the cross connection database.

1 41. The system of claim 31 further comprising:
2 a decoded audio common interface.

1 42. The system of claim 31 further comprising:
2 a compressed audio common interface.

1 43. A system controlling audio or multimedia conferences of a plurality of participants having
2 at least one participant that can participate in two or more conferences, the method comprising:
3 means for creating a cross conference database, the cross conference database including
4 connection parameters and connection statuses; and
5 means for performing a connection change using the cross conference database.

1 44. A method for making a system for controlling audio or multimedia conferences of a
2 plurality of participants having at least one participant that can participate in two or more
3 conferences the method comprising:
4 providing a management and controlling system within a multipoint control unit, the
5 management and control system creating a cross conference database, the cross
6 conference database including connection parameters and connection statuses;
7 and
8 configuring the multipoint control unit to perform a connection change based on the
9 cross conference database.

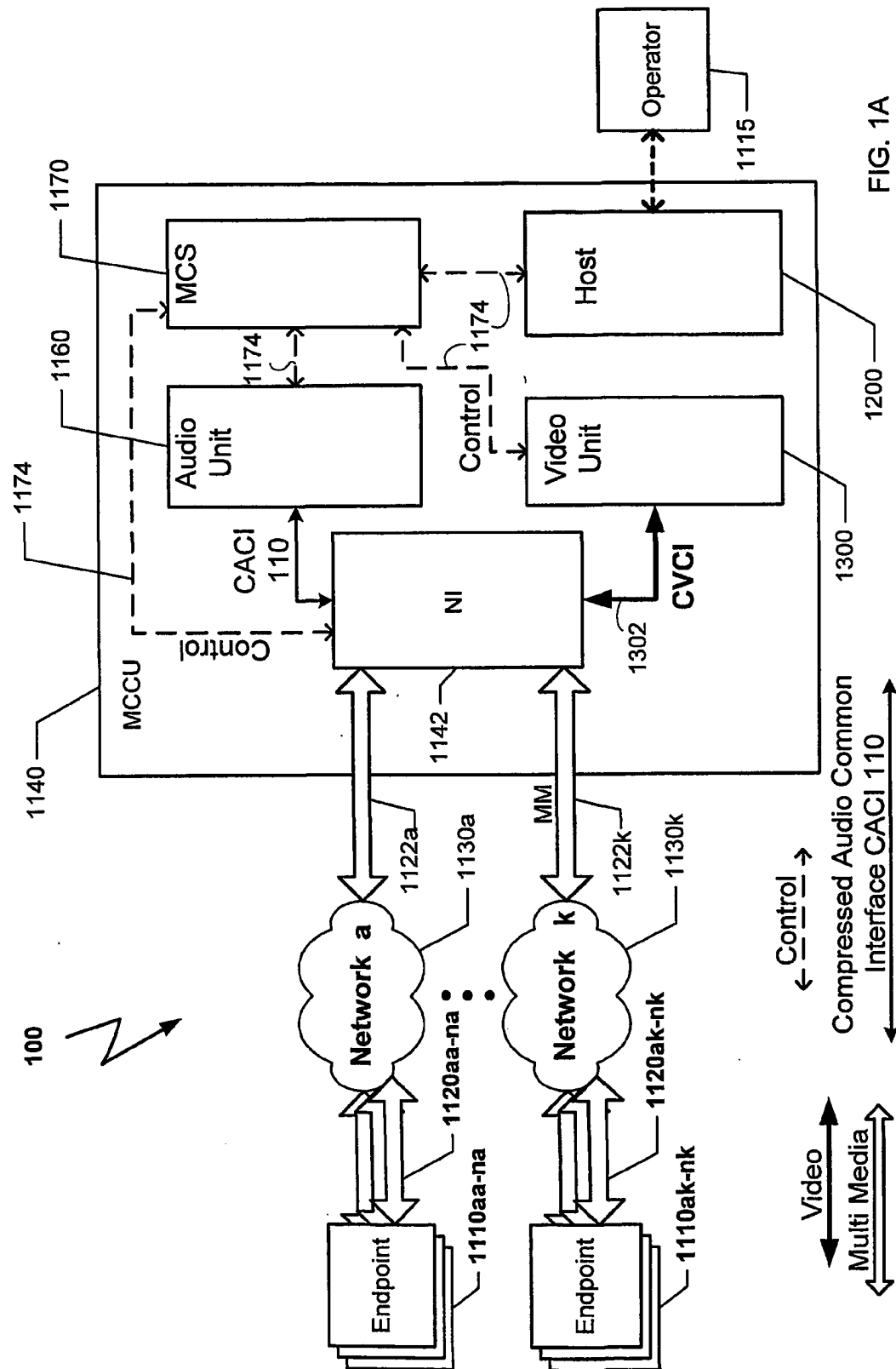


FIG. 1A

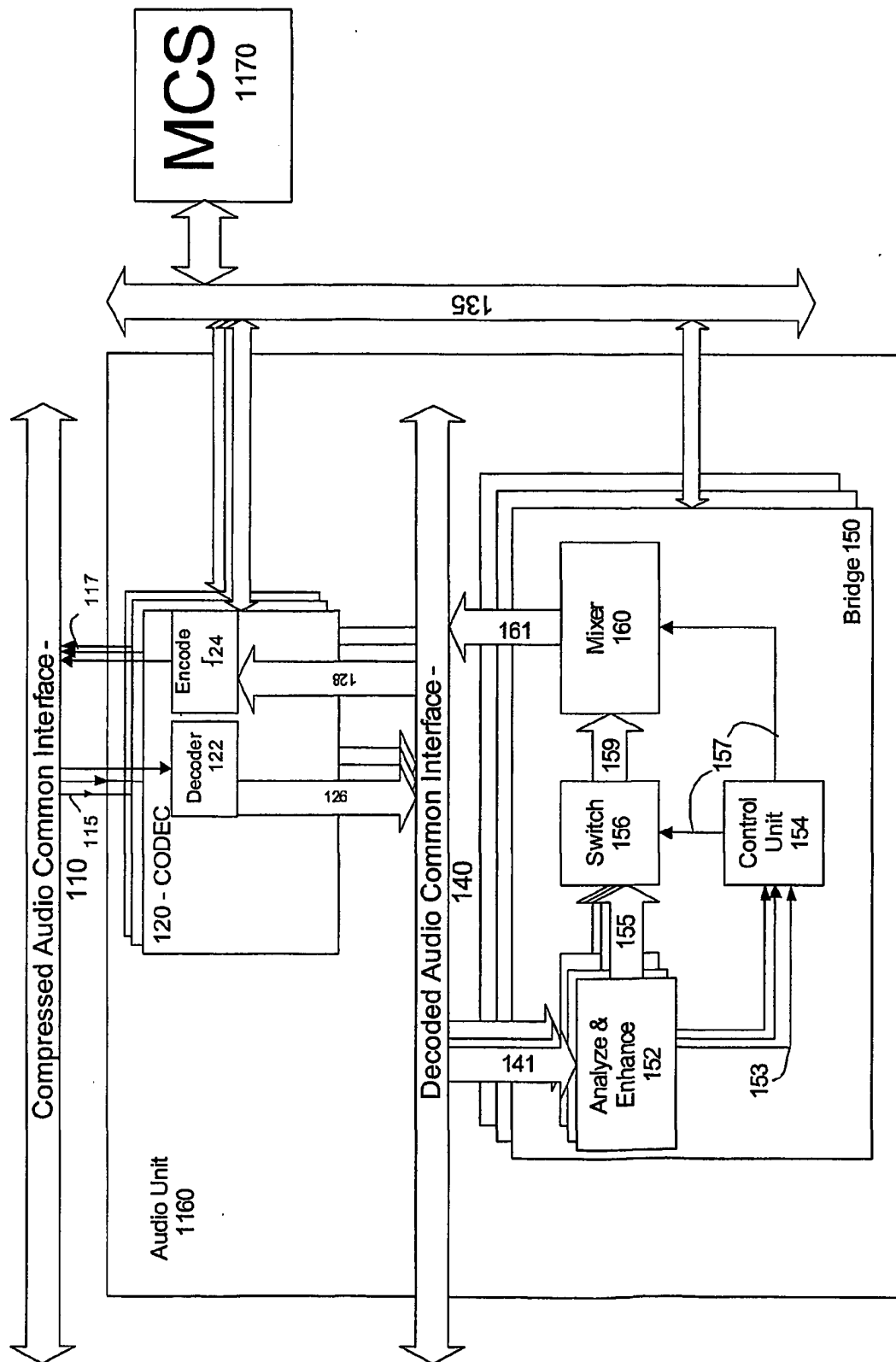


FIG. 1B

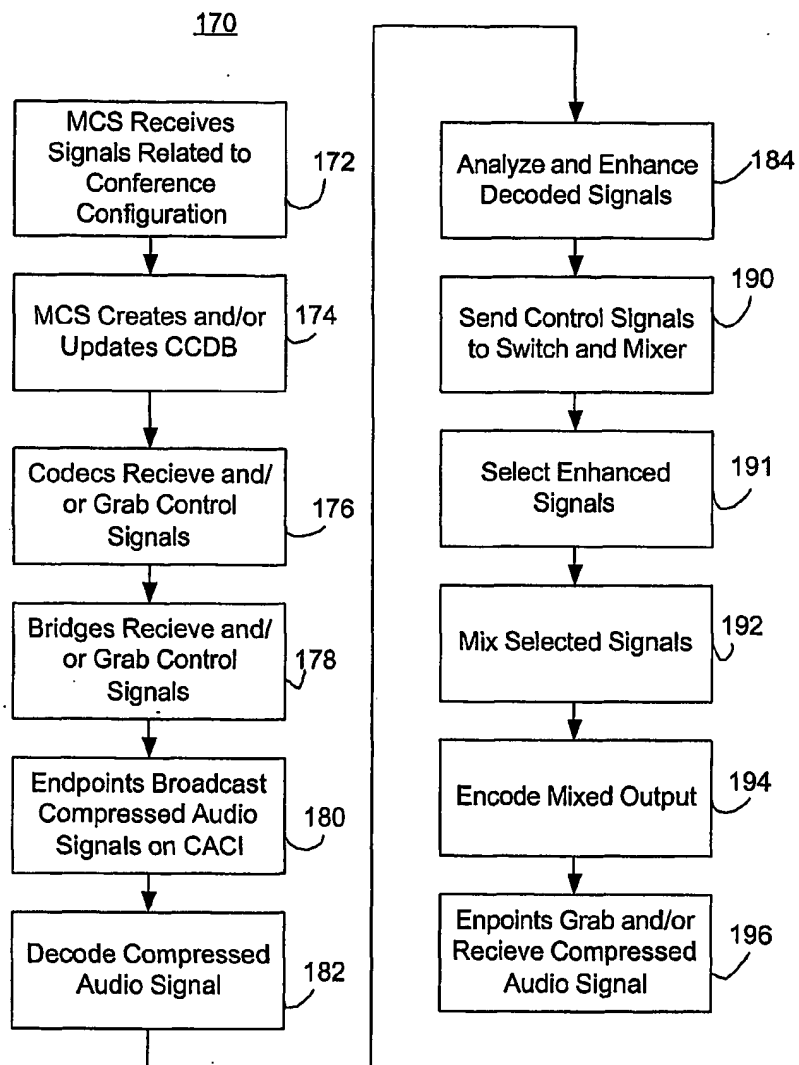


FIG. 1C

200

206

202

204

Participant	Conference: C # \ B#	A B3	B B1	C B5	D B4	.	.	.	X Bz
1 (E)	C11	N	S			.	.	.	
2 (F)	C21	S	N			.	.	.	
3 (E)	C13	N	S		(1)	.	.	.	
4 (F)	C05	S	N			.	.	.	
5 (E)	C07	N	S			.	.	.	
6 (FE)	C06	N				.	.	.	
7 (EF)	C17		N			.	.	.	
8	C08			N	S	.	.	.	
9	C01			N	S	.	.	.	
10	C10				N	.	.	.	
11	C04				N	.	.	.	
.
.
.
N	Cm					.	.	.	N
N+1	Cl					.	.	.	N
N+2	Ck					.	.	.	N

FIG. 2

FIG. 3

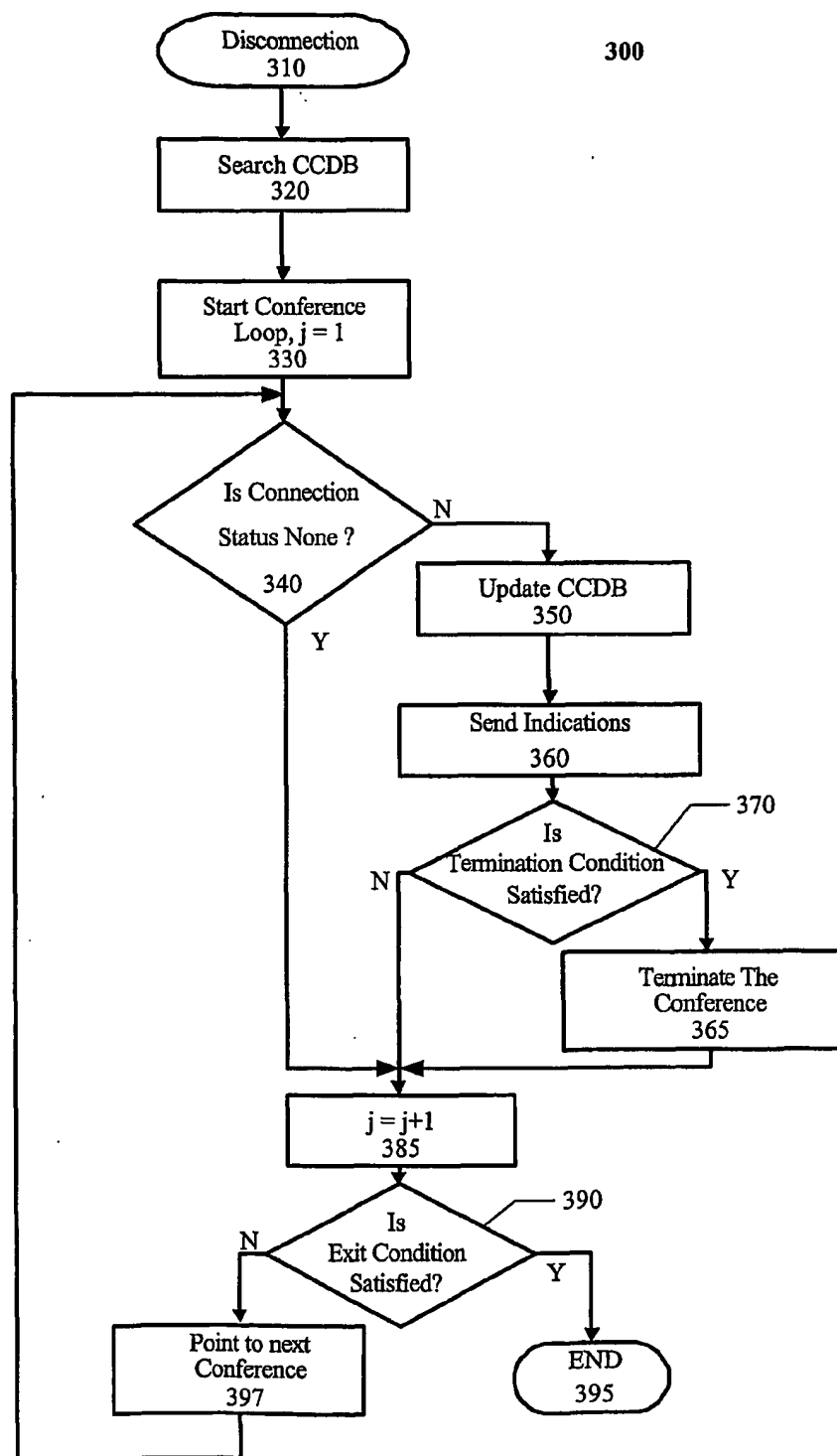
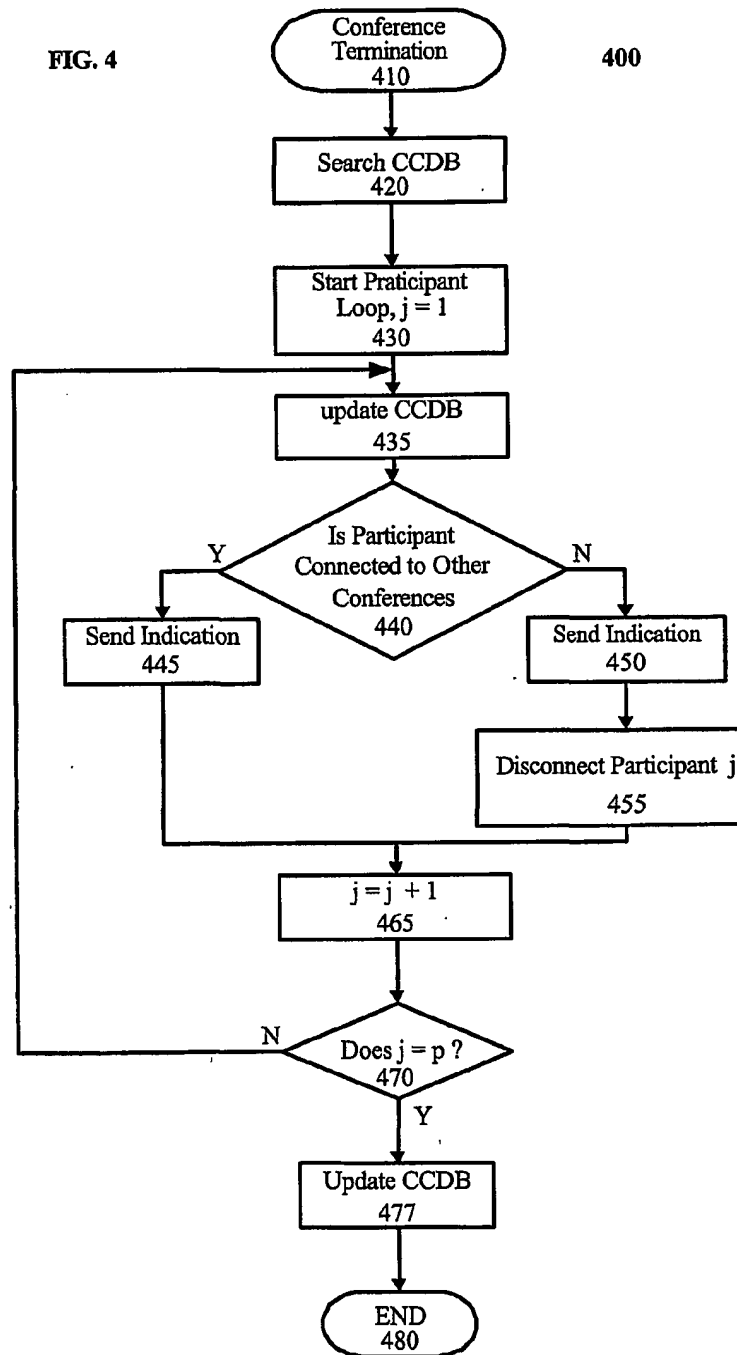


FIG. 4



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(71) Applicant (for all designated States except US): **POLY-COM ISRAEL LTD.** [IL/IL]; Bachar Avi, Derech Em HaMoshavot St. 94, P.O. Box 3654, 49130 Petach-Tikva (IL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **POTEKHIN, Sergey** [IL/IL]; Sitvanit St. 5/5, 71700 Modeine (IL). **KNAZ, Eran** [IL/IL]; Avshalom St. 6, 75285 Rishon LeZion (IL). **ELBAZ, Moshe** [IL/IL]; Keren HaYesod St. 19, 27000 Kiriath Bialik (IL).

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— with international search report

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27 February 2003

[Continued on next page]

(54) Title: CONTROL UNIT FOR MULTIPOINT MULTIMEDIA/AUDIO SYSTEM

Participant	Conference: C # \ B#	206		202		200											
		A	B	C	D												
		B3	B1	B5	B4												X
																	Bz
1 (E)	C11	N	S														
2 (F)	C21	S	N														
3 (E)	C13	N	S		(1)												
4 (F)	C05	S	N														
5 (E)	C07	N	S														
6 (FE)	C06	N															
7 (EF)	C17		N														
8	C08			N	S												
9	C01			N	S												
10	C10				N												
11	C04				N												
.
.
.
N	Cm																N
N+1	Cl																N
N+2	Ck																N

(57) Abstract: The present invention is a system and a method for providing a control unit for a multipoint multimedia/audio conference that enables one or more participants (1-N+2) to take part in more than one conference (A-X) simultaneously. The control unit can operate in audio and/or video sections of an MCU and/or Management and Control System (MCS). The MCS, in an exemplary embodiment of the present invention, controls the participation of at least one participant in more than one conference simultaneously by using a Cross-Conference Database (200). The MCU performs connection changes affecting which participants are associated with one or more conferences based on the information that is stored in the CCDB.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL02/00361

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06F 15/173

US CL : 709/223;224,227,204

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 709/223;224,227,204

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,230,197 B1 (BECK et al) 08 May 2001 col 10 lines 40-45; col 23 lines 8-17	1-44
Y	US 6,202,084 B1 (KUMAR et al) 13 March 2001 col 10 lines 32-50	1-44
Y	US 6,192,395 B1 (LERNER et al) 20 February 2001, col 3 lines 2-33	1-44
Y	US 6,170,011 B1 (MACLEOD BECK et al) 02 January 2001 col 10 lines 40-45; col 23 lines 3-14	1-44



Further documents are listed in the continuation of Box C.



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"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703)305-3230

Authorized officer

Mark Rinehart

Telephone No. 703-305-3800